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Impact of coronavirus disease on the HIV testing and health care delivery at a university hospital in Taiwan, 2020-2021

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Impact of coronavirus disease on the HIV testing and health care delivery at a university hospital in Taiwan, 2020-2021

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33 **Abstract**

34 **Background:** To contain the coronavirus disease 2019 (Covid-19) pandemic,
35 non-pharmacologic interventions, including lockdown and social distancing, may
36 have adverse impact on access to HIV testing and care. This study investigated the
37 impact of Covid-19 on HIV testing and care at a major hospital in Taiwan in 2020-
38 2021.

39 **Methods:** The numbers of clients seeking anonymous HIV voluntary counseling and
40 testing were compared 2 years before (2018-2019) and 2 years after Covid-19
41 outbreak (2020-2021). People living with HIV (PLWH) who sought care at the hospital
42 during 2018-2021 were included to examine the status of HIV care delivery and
43 disposition.

44 **Results:** The annual number of HIV screening tests performed had significantly
45 decreased from 2,507 and 2,794 in 2018 and 2019, respectively, to 2,161 and 1,737
46 in 2020 and 2021, respectively. The rate of discontinuation of HIV care among PLWH
47 was 3.7% in 2019, which remained unchanged in 2020 (3.7%) and 2021 (3.8%). The
48 respective percentage of annual plasma HIV RNA testing <2 times increased from
49 8.4% and 7.8% in 2018 and 2019 to 7.0% and 10.7% in 2020 and 2021, so was that of
50 annual syphilis testing <2 times (10.1% and 8.8% to 7.9% and 12.0%). The rates of
51 plasma HIV RNA <200 copies/ml ranged from 97.0% to 98.1% in 2018-2021.

52 **Conclusions:** During the Covid-19 pandemic, access to HIV counseling and testing
53 was significantly limited. While the number of HIV-related testing decreased, the
54 impact of Covid-19 on the continuity of antiretroviral therapy and viral suppression
55 among PLWH appeared to be minimal in Taiwan.

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58 **Introduction**

59 Coronavirus disease 2019 (Covid-19) has spread rapidly around the world since the
60 first report from Wuhan in China in December 2019.¹ Covid-19 may have short-term
61 and long-term detrimental health impact on the immune system, respiratory system,
62 cardiovascular system, neurological system and mental health.² During this Covid-19
63 pandemic, the World Health Organization (WHO) estimates that approximately 37.7
64 million people living with HIV (PLWH) worldwide are at risk for infection with severe
65 acute respiratory syndrome coronavirus 2 (SARS-CoV-2).³ To contain the pandemic,
66 wearing personal protective equipment, travel restrictions, social distancing, and
67 lockdown have been implemented, which could potentially have adverse impact on
68 HIV testing and care delivery, including initiation of antiretroviral therapy (ART) and
69 retention in HIV care.⁴⁻⁸ Because of non-pharmaceutical interventions (NPIs) and
70 concerns about acquisition of SARS-CoV-2, people at risk may become hesitant to
71 undergo timely testing for HIV and more likely to delay in seeking care when HIV
72 infection is confirmed, which could potentially lead to delayed initiation of
73 antimicrobial prophylaxis and ART and increased disease severity and
74 complications.^{9, 10} In a retrospective cohort study conducted in four continents, the
75 number of HIV tests performed was reduced by 35.4% in 2020 as compared with
76 that in 2019.⁶ In hospital-based studies, the new patient encounters decreased by

77 23.5% to 35.0% during the lockdown in the USA and the Netherlands.^{5,7} Moreover,
78 ART initiation was shown to decrease from a median of 571 per week before
79 lockdown to 375 per week after lockdown in 65 South African primary care clinics.⁴

80 While the extent to which the adverse impact of the pandemic may have
81 depends on the severity of the pandemic, preparedness of public and private
82 sectors, and efficiency of strategies to contain the pandemic, the patients with
83 chronic health conditions, including HIV, will be most severely hit in the long-term.¹⁰
84 A modelling study predicted that modest Covid-19-related disruptions to HIV testing,
85 initiation pre-exposure prophylaxis (PrEP) and PrEP adherence, condom use, ART
86 initiation and viral suppression could lead to increases in new HIV infections and HIV-
87 related deaths.¹¹ To minimize the adverse impact on the provision of HIV prevention
88 to key populations and the delivery of appropriate care to PLWH during the
89 pandemic, prevention and treatment programs need to be flexible and innovative
90 and to partner with non-governmental organizations.¹²⁻¹⁴

91 In this study, we aimed to investigate the impact of Covid-19 pandemic on the
92 HIV testing and care delivery at a university hospital in Taiwan during the outbreak in
93 2020 to 2021.

94

95 **Methods**

96 ***Study setting***

97 On 21 January, 2020, the first person infected with SARS-CoV-2 was diagnosed in the
98 Taiwan.¹⁵ As of 31 December, 2021, the total case number of SARS-CoV-2 infection
99 reported to the National Health Command Center (NHCC) was 14,603 cases in a
100 country with a population of around 24 million people. By the end of May 2022,
101 2,032,983 cases of SARS-CoV-2 infection were diagnosed with 2,255 deaths.¹⁶ To
102 contain the epidemic, border control, mandatory quarantine for returned travelers
103 and individuals infected with SARS-CoV-2, vaccination, and several NPIs were
104 implemented; these NPIs included wearing face mask and social distancing, in
105 addition to promoting awareness of personal hygiene and sanitation. Selective
106 restrictions on entry into the hospital were implemented with check-up of body
107 temperature and review of sick contacts, vaccination, and recent travel.¹⁷

108 Vaccination programs against SARS-CoV-2 started on March 22, 2021, which first
109 began to cover infectious disease prevention and control personnel at the central
110 and local governments and front-line workers at high risk of exposure. Adult people
111 with chronic illnesses, including PLWH, were prioritized in vaccination programs that
112 was initiated on 8 July, 2021.¹⁸ A retrospective study in Taiwan suggested that
113 COVID-19 vaccination was clinically effective in preventing SARS-CoV-2 infection

114 among PLWH.¹⁹ As of 31 May, 2022, it was estimated that 88.8% of the total
115 population had received the first dose, 81.9% the second, and 65.7% additional
116 doses of a Covid-19 vaccine in Taiwan.²⁰

117

118 ***HIV testing, prevention and care delivery***

119 HIV testing are mandatory for individuals entering military service, prisons and
120 correctional facilities. Opt-out HIV testing program has been implemented for
121 women receiving antenatal care since 2005. Free-of-charge HIV screening testing is
122 also provided at the designated hospitals and clinics. The program of home HIV
123 testing was implemented in 2020, in which the free-of-charge testing kits are
124 available at vending machines as well as convenience stores around Taiwan after
125 registration on-line with the Taiwan Center for Disease Control (CDC).

126 According to the national HIV treatment guidelines in Taiwan, PLWH have free-
127 of-charge access to HIV care, including ART and monitoring of CD4 and plasma HIV
128 RNA load, at designated hospitals around Taiwan. Antiretroviral-naïve PLWH are
129 counseled to start ART regardless of CD4 count since 2015.²¹ Several single-tablet
130 regimens (STRs), including regimens containing second-generation integrase
131 inhibitors, were introduced into clinical use in 2016. Initiation of ART within 7 days of
132 HIV diagnosis was recommended in 2018; after introduction of

133 immunochromatographic testing to facilitate rapid confirmation of HIV diagnosis in
134 2020, same-day ART initiation was recommended in 2021.²² Once ART is initiated,
135 follow-up of virologic response is conducted at 1 month of ART, and subsequently
136 every 3 months during the first year and every 6 months once PLWH have achieved
137 viral suppression on stable ART.²³ The annual number of newly diagnosed HIV
138 infection reported to the Taiwan CDC reported has been on the decline for four
139 consecutive years since 2018.²⁴

140 During the epidemic, HIV care provided at designated hospitals around Taiwan
141 was not interrupted, including PrEP and post-exposure prophylaxis (PEP), HIV
142 screening, ART, and management of opportunistic illnesses. PLWH who stayed
143 abroad or were quarantined could have their ART refilled at the designated hospitals
144 and delivered by mail with the assistance of their families, friends, or volunteer
145 workers at non-governmental organizations (NGOs). PLWH can refill ART by making
146 on-line appointments with designated hospitals or pharmacies.

147

148 ***Study population and design***

149 In this retrospective cohort study, we included PLWH receiving care at the National
150 Taiwan University Hospital (NTUH), the major designated hospital providing inpatient
151 and outpatient care, in 2018-2021. To examine the impact of Covid-19 on HIV testing,

152 the numbers of clients seeking anonymous HIV voluntary counseling and testing
153 (VCT) in the same periods in 2018-2021 were compared. To evaluate the linkage to
154 care for those testing HIV-positive, the interval between HIV diagnosis and first visit
155 at HIV clinics as well as that between confirmed HIV diagnosis and ART initiation
156 were recorded.

157 We systematically extracted and validated all laboratory and clinical data from
158 the electronic medical records. Patients were included if they had at least one
159 medical visit at NTUH between January 1, 2018, and December 31, 2021.
160 Discontinuation of HIV care was defined as individuals having less than 1 medical visit
161 within 6 months. Follow-up was censored at death or at the end of study on 31
162 December, 2021. Outcomes assessed included attendance at the HIV clinics by PLWH
163 themselves, family, friends or non-governmental organizations; performance of HIV
164 care-related testing such as rapid plasma reagin (RPR) for syphilis, hepatitis C virus
165 (HCV) antibodies or HCV RNA, and plasma HIV RNA; and plasma HIV RNA <200
166 copies/ml or <50 copies/ml. These variables were chosen to assess the HIV care
167 continuum that encompasses a series of HIV care-related steps from HIV diagnosis to
168 linkage to care, retention in care, and to viral suppression.²⁵

169

170 ***Laboratory investigations***

171 Plasma HIV RNA load was quantified using the Cobas HIV-1/HIV-2 Qualitative nucleic
172 acid test (Cobas 6800 System, Roche Diagnostics Corporation, IN, USA) with the
173 lowest detection limit of 33 IU/mL (1 copy=1.67 IU). CD4 counts were determined
174 using FACFlow (BD FACS Calibur, Becton Dickinson, CA, USA). ASI's nontreponemal
175 RPR test screens (CPT Code 86593, Springville, UT, USA) was used for the
176 diagnosis of syphilis. Anti-HCV antibodies were determined with the use of a
177 fourth-generation enzyme immunoassay (Dia.Pro Diagnostic Bioprobes S.r.l. Italy).
178 The detection of HCV RNA was performed using Roche Cobas® 6800 system
179 (AmpliPrep HCV Test, v2.0, Roche, USA), with a detection limit of 15 IU/ml. In June
180 2019, pooled-plasma HCV RNA testing program was implemented to facilitate early
181 diagnosis of HCV viremia and linkage to direct-acting antiviral (DAA) treatments
182 among PLWH at risk for HCV acquisition, such as PLWH newly diagnosed with
183 sexually transmitted infections (STIs), elevated aminotransferases, and recent
184 clearance of HCV with DAAs or spontaneously; those included in the program
185 underwent HCV RNA testing every 12 weeks for 48 weeks.²⁶

186

187 ***Statistical analysis***

188 We used descriptive statistics to summarize the VCT testing for HIV and clinical data
189 among PLWH before and after Covid-19 outbreak. The variables included in this

190 analysis were the number of HIV tests performed and the percentage of clients
191 testing HIV-positive at the VCT service; and the coverage of Covid-19 vaccination and
192 the number of attendance at the HIV clinics, and plasma HIV RNA and RPR tests
193 performed. Differences in the numbers of HIV tests and percentages of clients testing
194 HIV-positive for the four consecutive study years were compared by p for trend. SAS
195 (version 9.4) was used for all analyses.

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200

201 **Results**

202 ***Trends of HIV testing performed at VCT service***

203 The number of HIV tests performed at VCT service had significantly decreased, from
204 2,507 and 2,794 in 2018 and 2019, respectively, to 2,161 and 1,737 in 2020 and
205 2021, respectively, a 37.8% decrease from 2019 to 2021 (Figure 1). However, the
206 percentages of clients testing HIV-positive remained relatively stable during the 4-
207 year study period, from 0.8% (n=20) and 1.1% (31) in 2018 and 2019, respectively, to
208 0.6% (13) and 1.4% (25) in 2020 and 2021, respectively (*P* for trend, 0.34) (Figure 1).

209 The rate of linkage to care for the clients testing HIV-positive at VCT service was
210 85.0% (17/20), 93.5% (29/31), 100% (13/13), and 96.0% (24/25) in 2018, 2019, 2020,
211 and 2021, respectively.

212

213 ***SARS-CoV-2 vaccine coverage***

214 Types of vaccines available in Taiwan included ChAdOx1 nCoV-19 (AZD1222),
215 BNT162b2 (Pfizer-BioNTech), mRNA-1273 (Moderna), and MVC-COV1901 (Medigen);
216 PLWH traveling to China might receive CoronaVac (Sinovac) or BBIBP-CorV
217 (Sinopharm) vaccines. From February 2 2021 to December 31, 2021, 87.0%
218 (2974/3420) PLWH had received 2 vaccine doses (Figure 2); the types of vaccines
219 administered were 96.5% (2870/2974) homologous vaccines (AZD1222-AZD1222,

220 n=1,736; BioNTech-BioNTech, n=384; Moderna-Moderna, n=610; Medgen-Medgen,
221 n=118; Sinovac- Sinovac, n=14, Sinopharm- Sinopharm, n=8); and 3.5% (104/2974)
222 heterologous vaccines (AZD1222-BioNTech, n=31; AZD1222-Moderna, n=72;
223 AZD1222-Medgen, n=1).

224

225 ***HIV care delivery to people who were newly diagnosed with HIV infection***

226 The numbers and clinical characteristics of PLWH who sought HIV care during the
227 four study years are shown in Table 1. The majority of the included PLWH were male
228 (ranging from 95.9% to 96.2%) and men who have sex with men (from 90.9% to
229 91.9%). The annual case number of people who were newly diagnosed with HIV
230 infection and sought care at this hospital had decreased from 85 and 86 in 2018 and
231 2019, respectively, to 55 and 53 in 2020 and 2021, respectively. The median CD4
232 count at HIV diagnosis of those people newly diagnosed with HIV infection had
233 decreased from 278 and 259 cells/mm³ in 2018 and 2019, respectively, to 222 and
234 257 cells/mm³ in 2020 and 2021, respectively; and the proportion of those who had
235 CD4 counts <200 cells/mm³ at HIV diagnosis remained high, 35.3%, 36.0%, 45.5%,
236 35.8% in 2018, 2019, 2020, and 2021, respectively (p for trend, 0.38). The interval
237 (median [IQR], days) between confirmed HIV diagnosis to ART initiation had
238 shortened from 5 (IQR, 2-7) to 0 (IQR, 0-1) days in 2018-2021 (Table 1). Overall,

239 85.7% (239/279) started ART within 7 days of HIV diagnosis for all people newly
240 diagnosed with HIV during the four study years; and 24.7% (69/279) started ART on
241 the same day of HIV diagnosis. The percentage of people newly diagnosed with HIV
242 infection and started ART on the same day of HIV diagnosis had increased from
243 11.3% in 2018 to 69.8% in 2021.

244

245 ***Trends of retention in care among PLWH***

246 During the 4-year study period, a total of 3,420 PLWH sought HIV care. At the end of
247 2018, 3,116 continued to receive care at NTUH. The rate of discontinuation of HIV
248 care of those having sought HIV care in 2018 was 3.7% in 2019, which remained
249 unchanged in 2020 (3.7%) and 2021 (3.8%) (Table 2). Overall, 88 (2.6%) PLWH who
250 stayed abroad had their ART refilled and delivered with the assistance of their
251 families, friends, or volunteer workers of NGOs in 2019-2021.

252

253 ***Trends of HIV-related testing***

254 In addition to ART refills and the rates of loss to follow-up, we used the numbers of
255 RPR testing, CD4 count and plasma HIV RNA as surrogates for HIV care delivery
256 during the 4-year study period (Table 1). Before the pandemic, the total number of
257 RPR tests performed for syphilis was 7,816 in 2018 and 7,895 in 2019, which had

258 decreased to 7,545 in 2020 and 7,207 in 2021. The total numbers of anti-HCV
259 antibody or HCV RNA testing were 3,216 and 4,276 in 2018 and 2019, respectively,
260 which had increased to 4,783 in 2020 and 4,823 in 2021. The average number of anti-
261 HCV antibody or HCV RNA testing per year had increased from 1.03 in 2018 to 1.51
262 times in 2021. The proportion of PLWH without anti-HCV or HCV RNA testing had
263 decreased from 33.3% in 2018 to 7.8% in 2021 (Table 1). The total numbers of
264 plasma HIV RNA testing were 7,927 and 7,839 in 2018 and 2019, respectively, which
265 had decreased to 7,509 in 2020 and 7,205 in 2021. However, the proportions of
266 plasma HIV RNA ≤ 200 copies/ml in the on-treatment populations were similar,
267 97.0% in 2018, 97.3% in 2019, 98.1% in 2020, and 97.7% in 2021, so were the rates of
268 plasma HIV RNA ≤ 50 copies/ml in the modified intention-to-treat populations for the
269 four study years (Table 1).
270
271

272 Discussion

273 In this retrospective observational study, we showed that the number of HIV
274 screening tests performed at VCT service had significantly decreased by nearly 40%
275 after the Covid-19 outbreak in 2020 and 2021. During the 4-year study period, the
276 annual rates of loss to follow-up remained stable (3.7-3.8%). While the total annual
277 number of plasma HIV RNA testing had decreased from 7,927 in 2018 to 7,205 in
278 2021, the rates of viral suppression among those who had their plasma HIV RNA
279 determined remained high. Despite the negative impact of Covid-19 outbreak on HIV
280 testing and HIV care delivery, the intervals from HIV diagnosis to ART initiation
281 continued to shorten with the introduction of immunochromatographic assay to
282 facilitate rapid confirmation of HIV infection and single-tablet antiretroviral regimens
283 to improve adherence and tolerability in Taiwan.²²

284 Covid-19 pandemic could have negative impact on HIV care delivery and result
285 in the increases of the number of HIV late presenters, STIs and new HIV infections.¹¹
286 The finding of significant decreases of HIV testing provided at hospital-based VCT
287 service in our study was similar to those observed in previously studies.^{4,6} During the
288 pandemic, access to testing could be significantly hindered because of restrictions on
289 entry into the hospital and lockdown; moreover, people may have concerns about
290 contracting SARS-CoV-2 during traveling to the hospitals or at the hospitals. Delays in

291 seeking HIV testing may increase the risk of late presentation of HIV infection, as
292 shown in the observational study in the Netherlands, which demonstrated a higher
293 proportion of late presentation among the new HIV referrals after lockdown due to
294 Covid-19 outbreak.⁵ In this study, we found that the proportions of people newly
295 diagnosed with HIV infection who presented with CD4 counts <200 cells/mm³ were
296 35%-36% in 2018-2019 to 36-46% in 2020-2021 (p for trend, 0.38). Delayed HIV
297 diagnosis may potentially increase the risk of HIV transmission, and late presentation
298 may increase the risk of developing opportunistic illnesses and mortality and the
299 medical expenditure in managing the opportunistic illnesses. To overcome the
300 adverse impact of Covid-19, programs and strategies have been developed, including
301 telephone screening of clients for COVID-19 symptoms before they visit testing
302 services, syndromic management of STIs symptoms by telemedicine, and home-
303 based self-testing for HIV and STIs under the supervision of program staff in the
304 USA.¹²

305 Previous studies have shown that ART initiation, clinic visits, plasma HIV RNA
306 testing and virologic suppression among PLWH decreased during the Covid-19
307 pandemic.^{4,7} The HIV testing and ART initiation were most affected due to a paucity
308 of personal protective equipment and space for physical distancing in clinics, as well
309 as shortened clinic opening times and staff being redeployed from HIV testing to

310 Covid-19 response activities.^{4, 27} To minimize the disruptions on ART, differentiated
311 service delivery programs were implemented and the clinics and pharmacies were
312 able to facilitate ART provision through strategies such as multi-month dispensing,
313 ART provision outside of conventional healthcare facilities.^{12, 28} During the Covid-19
314 pandemic, the development of alternative options for health care delivery were
315 accelerated, which included telemedicine, scheduled facility-based appointments,
316 home-base appointments, extended ART dispensation/refill, ART dispensation at
317 satellite clinics, and home delivery of drugs. In our study, we found that the
318 disruptions to ART initiation, hospital- or pharmacy-based ART refills and clinic visits
319 were minimal. Although our infectious diseases physicians were the main task force
320 to be in charge of infection control and care of people with COVID-19 in Taiwan,
321 these same infectious diseases physicians continued to provide HIV care services in
322 collaboration with HIV case manager, consultation staff and researchers for PLWH.
323 While the numbers of plasma HIV RNA testing decreased for two consecutive years
324 into Covid-19 pandemic, the rates of viral suppression remained high and the rates of
325 discontinuation and loss to follow-up remained low throughout the four consecutive
326 study years. Moreover, rapid and same-day ART initiation programs implemented
327 were not affected for those who newly received HIV diagnosis.
328 Our study showed reductions in the numbers of RPR testing among PLWH.

329 While it is not clear whether lockdown or social distancing would have any impact on
330 the acquisition of STIs, the decreases of RPR testing raised concerns about delay in
331 detection of syphilis and other STIs. However, we found that the numbers of HCV
332 testing, including anti-HCV antibody and HCV RNA testing, continued to increase in
333 2018-2021. Because Taiwan government has committed to HCV elimination by 2025,
334 implementation of HCV testing programs and improvement in accessing DAA
335 treatments by lifting the restrictions might have encouraged health care providers to
336 perform HCV testing.²⁹ The implementation of pooled-plasma HCV RNA testing
337 program among high-risk PLWH would increase the numbers and proportions of
338 PLWH undergoing HCV testing after 2019.²⁶ Our recent finding of declining incidence
339 and prevalence of HCV viremia among PLWH at this hospital suggests that Covid-19
340 did not have negative impact on our progress toward HCV microelimination.³⁰

341 There are several limitations to our study. First, it is an observational study
342 conducted at a single center. While the HIV care follows the national treatment
343 guidelines and HIV care, including ART and laboratory testing, is fully reimbursed, our
344 findings might not be generalizable to other designated hospitals for HIV care around
345 Taiwan. Second, the case number of Covid-19 recorded in Taiwan remained relatively
346 smaller compared to those in other countries during the study period, which might
347 be contributory to the relatively minimal impact observed on HIV care delivery. Our

348 observation in Taiwan could not be generalized to those in other settings where
349 medical facilities are overwhelmed in providing care to people with Covid-19. Third,
350 the impact of significant decreases in HIV testing at VCT service needs further
351 attention, though the government has increased the distribution of HIV testing kits
352 through the vending machines and convenient stores islandwide. Fourth, this current
353 study spanned 2018-2021 and did not include 2022; therefore, the findings observed
354 in this study might not be generalizable to the situation in 2022, when Omicron
355 variants have become predominant.

356 In conclusion, our study showed that the Covid-19 pandemic has led to
357 reductions of the numbers of HIV screening testing at VCT service and the numbers
358 of most HIV care-related testing; however, the programs of rapid and same-day ART
359 initiation, continuity of ART and achievement of viral suppression with ART appeared
360 to be minimally affected by Covid-19 in Taiwan.

361

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363

364 **Conflict of Interest**

365 None of the authors has known competing financial interests or personal
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367

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371

372 **Ethical Approval statement**

373 The study was approved by the Research Ethics Committee (registration number,
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375

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Table 1. Clinical characteristics of people living with HIV who sought care at the National Taiwan University Hospital and blood testing related to HIV care performed between 2018 and 2021

	2018	2019	2020	2021
Total patient number, n=	3116	3177	3178	3188
Age, mean (SD), years	41.1 (11.0)	41.8 (10.9)	42.6 (10.9)	<u>43.4</u> (10.9)
Male sex, n (%)	2988 (95.9)	3051 (96.0)	3055 (96.1)	3066 (96.2)
Risk group for HIV transmission, n (%)				
MSM	2831 (90.9)	2895 (91.1)	2904 (91.4)	2929 (91.9)
Heterosexuals	249 (7.9)	246 (7.7)	241 (7.6)	230 (7.2)
IDUs	29 (0.9)	29 (0.9)	26 (0.8)	22 (0.9)
Others	7 (0.2)	7 (0.2)	7 (0.2)	7 (0.2)
Plasma HIV RNA, mean (SD), log ₁₀ copies/ml	1.4 (0.5)	1.4 (0.5)	1.4 (0.4)	1.4 (0.4)
People newly diagnosed with HIV infection, n (%)	85 (2.7)	86 (2.7)	55 (1.7)	53 (1.7)
CD4 count at diagnosis, median (IQR), cells/ μ L	278 (156-413)	259 (89-413)	222 (72-367)	257 (71-360)
CD4 <200 cells/ μ L, n (%)	30 (35.3)	31 (36.0)	25 (45.5)	19 (35.8)
Plasma HIV RNA, median (IQR), log ₁₀ copies/ml	4.9 (4.6-5.4)	5.0 (4.4-5.4)	5.1 (4.6-5.8)	5.2 (4.3-5.9)
Plasma HIV RNA >5 log ₁₀ copies/ml, n (%)	40 (47.1)	42 (48.8)	31 (56.4)	27 (52.9)
Interval between diagnosis and ART initiation, median	5 (2-7)	5 (3-7)	5 (2-7)	0 (0-1)

(IQR), days				
Total number of RPR tests performed	7816	7895	7545	7207
No. of annual RPR tests for each PLWH, median (IQR)	2 (2-3)	2 (2-3)	2 (2-3)	2 (2-3)
PLWH without any RPR test, n (%)	<u>63 (2.0)</u>	<u>60 (1.9)</u>	<u>75 (2.4)</u>	<u>112 (3.5)</u>
PLWH with annual RPR tests <2, n (%)	<u>316 (10.1)</u>	<u>278 (8.8)</u>	<u>252 (7.9)</u>	<u>384 (12.0)</u>
PLWH with annual RPR tests ≥2, n (%)	<u>2737 (86.4)</u>	<u>2839 (89.4)</u>	<u>2851 (89.7)</u>	<u>2692 (84.4)</u>
Total number of anti-HCV antibodies or HCV RNA tests performed	3216	4276	4783	4823
No. annual anti-HCV antibody or HCV RNA tests for each PLWH, median (IQR)	1 (0-1)	1 (1-2)	1 (1-2)	1 (1-2)
PLWH without any anti-HCV antibody or HCV RNA test, n (%)	1039 (33.3)	312 (9.8)	360 (11.3)	249 (7.8)
Total no. plasma HIV RNA tests performed	7927	7839	7509	7205
No. annual viral load test for each PLWH, median (IQR)	2 (2-3)	2 (2-3)	2 (2-3)	2 (2-3)
<u>PLWH without any viral load</u>	<u>36 (1.2)</u>	<u>38 (1.2)</u>	<u>57 (1.8)</u>	<u>94 (2.9)</u>

<u>test, n (%)</u>				
<u>PLWH with annual viral load tests <2, n (%)</u>	<u>262 (8.4)</u>	<u>247 (7.8)</u>	<u>223 (7.0)</u>	<u>342 (10.7)</u>
<u>PLWH with annual viral load test ≥2</u>	<u>2818 (90.0)</u>	<u>2892 (91.0)</u>	<u>2898 (91.2)</u>	<u>2752 (86.3)</u>
Plasma HIV RNA ≤200 copies/ml in on-treatment population*	97.0% (2988/3080)	97.3% (3037/3122)	98.1 % (3013/3070)	97.7% (3023/3093)
<u>PVL<200 copies/ml in modified intention-to-treat population**</u>	<u>95.9%</u> <u>(2988/3116)</u>	<u>95.6%</u> <u>(3037/3177)</u>	<u>94.8%</u> <u>(3013/3178)</u>	<u>94.8%</u> <u>(3023/3188)</u>
Plasma HIV RNA ≤50 copies/ml in on-treatment analysis*	94.9% (2925/3080)	94.9% (2962/3122)	95.3% (2927/3070)	93.9% (2905/3093)
<u>PVL<50 copies/ml in modified intention-to-treat population**</u>	<u>93.8%</u> <u>(2925/3116)</u>	<u>93.2%</u> <u>(2962/3177)</u>	<u>92.1%</u> <u>(2927/3178)</u>	<u>91.1%</u> <u>(2905/3188)</u>

*On-treatment analysis by including only those who were receiving ART and had undergone PVL testing in each study year

**Modified intention-to-treat analysis by including all PLWH receiving ART in each study year. In this analysis, those PLWH who had not undergone PVL testing were considered to have virologic non-suppression in the respective estimation of viral suppression defined as PVL <50 copies/ml or <200 copies/ml.

Abbreviations: ART, antiretroviral therapy; HCV, hepatitis C virus; IDU, injection drug users; IQR, interquartile range; MSM, men who have sex with men; PLWH, people living with HIV; RPR, rapid plasma reagin; SD, standard deviation

Table 2. Disposition of people living with HIV seeking care at the National Taiwan University Hospital in 2019-2021

	2019	2020	2021	All
N	3177	3178	3188	3420
Transfer of care to other hospitals, n (%)	55 (1.7)	47 (1.5)	49 (1.5)	151 (4.4)
Staying abroad, n (%)	10 (0.31)	10 (0.31)	12 (0.31)	32 (0.94)
Loss to follow up, n (%)	32 (1.0)	39 (1.2)	43 (1.3)	114 (3.3)
Death, n (%)	15 (0.5)	12 (0.4)	15 (0.5)	42 (1.2)
Incarceration, n (%)	7 (0.2)	9 (0.3)	5 (0.2)	21 (0.6)
<u>Discontinuation of care, n (%)</u>	<u>119 (3.7)</u>	<u>117 (3.7)</u>	<u>124 (3.8)</u>	<u>360 (10.5)</u>

Figure 1. The numbers of for HIV tests performed at voluntary counseling and testing service (bar) and the rates of HIV seropositivity (curve) in 2018-2021

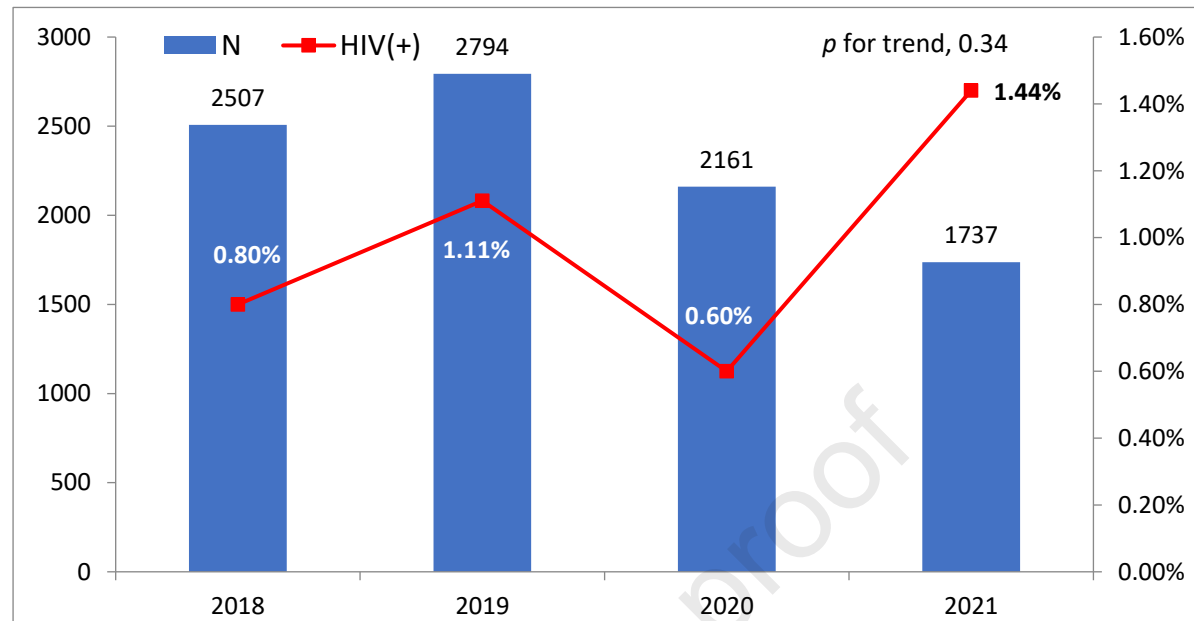


Figure 2. Cumulative coverage of COVID-19 vaccination among people living with HIV (PLWH) seeking care at the National Taiwan University Hospital in February to December 2021

